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NAVAL AIR WARFARE CENTER WEAPONS DIVISION

DEPARTMENT OF THE NAVY

PERFORMANCE SPECIFICATION

FOR THE

HIGH DYNAMIC

JOINT ADVANCED MISSILE INSTRUMENTATION (JAMI)

GLOBAL POSITIONING SYSTEM SENSOR UNIT (GSU)

This specification consists of pages i to vii and
pages 1 through 60 with Appendix A, inclusive.

Approved:
By Direction

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RECORD OF CHANGES

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15 August 2002	C	9 thru 13, 54	NOR CL02-005.01R1

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1.0 SCOPE

This specification establishes the performance requirements for a high dynamic global positioning system (GPS) sensor unit (GSU). The GSU will provide time-space-position information (TSPI) and critical event time-tagging. The GSU will be installed in a Joint Advanced Missile Instrumentation (JAMI) TSPI Unit (JTU) that will be installed in surface-to-air, air-to-surface, and air-to-air missiles (see 6.1).

2.0 APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards and handbooks.

STANDARDS

MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-461	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment
MIL-STD-810	Test Method Standard, Environmental Engineering Considerations, and Laboratory Tests

HANDBOOKS

MIL-HDBK-217	Reliability Prediction of Electronic Equipment
MIL-HDBK-263	Electrostatic Discharge Control Handbook for Protection of Electrical and Electronic Parts, Assemblies, and Equipment (Excluding Electrically Initiated Explosive Devices)
MIL-HDBK-781	Reliability Test Methods, Plans, and Environments of Engineering Development, Qualification, and Production

(Unless otherwise indicated in the solicitation, copies of federal and military specifications, standards, and handbooks are available from the Standardization Document Order Desk (Building 4D), 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.1.2 Other government documents and drawings.

Documents

TE000-AB-GTP-010	Parts Derating Requirements and Application Manual for Navy Electronic Equipment

(Request for copies should be directed to Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120-5099.)

NAWCWPNS Cage Code 12934

NAWC-CH 3132	Naval Air Warfare Center Weapons Division Department Of The Navy Definitions Specification For The Joint advanced Missile Instrumentation (JAMI) Time, Space, Position Information (TSPI) Unit Message Structure (TUMS) Digital Protocol

(Request for copies should be directed to Commanding Officer, Naval Air Warfare Center Weapons Division, Code 543E00D, China Lake, CA 93555-6100.)

2.2 Order of precedence. In case of a conflict between the text of this specification and the references cited herein, the text of this specification takes precedence. Nothing in this specification; however, supersedes applicable laws and regulations unless a specific exemption has been obtained. In case of a conflict between the text of this specification and the contract, the contract takes precedence.

3.0 REQUIREMENTS

3.1 Qualification sample. When specified in the SOW or contract (see 6.2), a sample shall be subjected to qualification inspection in accordance with 4.2. The sample size shall be in accordance with the contract (see 6.2).

3.2 Materials and parts.

3.2.1 Selection of materials and parts. The contractor shall select the materials and parts subject to the following conditions:

a. Materials and parts selected shall meet all of the design, operational, performance, and environmental requirements specified herein.

b. The materials and parts selected shall have no structural or physical integrity degradation after exposure to the environmental conditions specified herein.

c. Materials that are nutrients for fungus shall not be used.

d. Materials and parts requiring environmental handling and disposal considerations shall not be used without prior approval by the procuring agency.

3.2.2 Parts stress derating. Parts shall be derated through stress analysis of parts and materials (electrical, mechanical, and thermal) to comply with the parts derating requirements of TE000-AB-GTP-010, Parts Requirements and Application Manual for Navy Electronic Equipment. Linear devices and voltage regulators, hermetically sealed or non-hermetically sealed, shall be derated in accordance with Figures 1 and 2, respectively. Digital devices, hermetically sealed or non-hermetically sealed, shall be derated in accordance with Table I, with the exception that operating junction temperatures shall not exceed +230° Fahrenheit in system operation unless otherwise approved. This junction temperature limitation does not apply to semiconductors specifically designed for high power applications. Very high speed integrated circuits devices, non-hermetically sealed shall be derated in accordance with Table II.

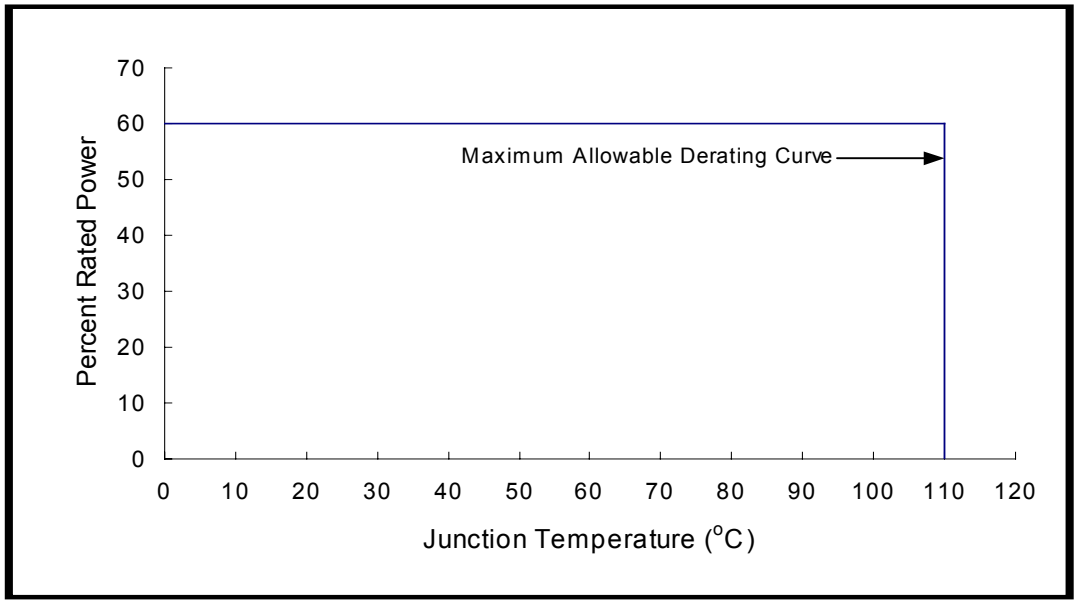


FIGURE 1. **Derating requirements for hermetically sealed voltage regulators at T_s = 110°C**

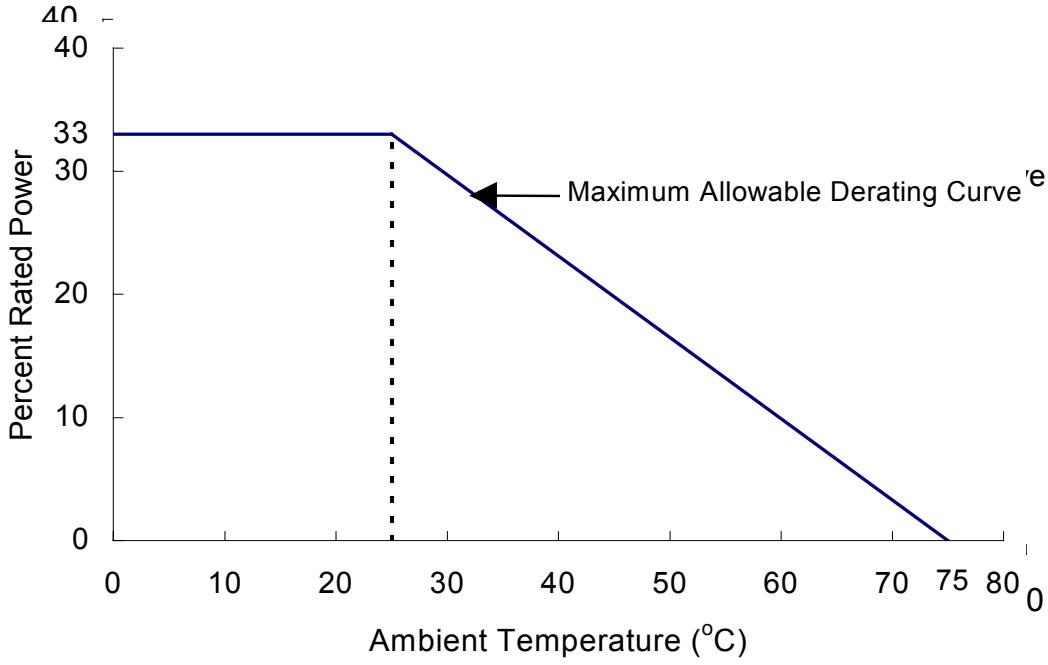


FIGURE 2. **Derating requirements for non-hermetically sealed microcircuits, except voltage regulators, at T_s = 25°C**

TABLE I. Derating parameters for digital microcircuits.

Parameter	% of Maximum Rated Value
Junction temperatures	100°C* maximum
Supply voltage	Do not exceed manufacturer's nominal rating
Toggle frequency	70
Set up and hold time	200 minutes
Fanout	80

*This value represents the actual temperature and not a percentage.

TABLE II. T_j* versus line width.

T_j	Line Width
≤110°C	2 microns
≤100°C	1.5 to 2 microns
≤95°C	1.0 to 1.5 microns
≤85°C	submicron

*T_j - Maximum operating function temperature.

3.3 Design. The GSU shall perform as specified herein, when subjected to severe environmental and flight conditions, which shall occur with the installation, launch, and flight of the GSU installed in a weapon system. This includes being carried by and launched from military aircraft.

3.3.1 Interfaces. The GSU design shall comply with the mechanical, electrical, and signal interface requirements specified in the Interface Control Document (ICD), Appendix A.

3.3.2 Voltage and radio frequency input protection.

3.3.2.1 Voltage input. The GSU shall not be damaged, if any of the input voltages specified in the GSU ICD fall below the specified levels. Normal operation of the GSU is not required, when the under voltage condition exists. However, performance as specified herein is required after the voltages are restored to the specified levels.

3.3.2.2 Radio frequency power input. The GSU shall not be damaged by the application of radio frequency (RF) power to the GSU antenna port (J1), to a maximum of 0.1 watt, at any frequency except L1 ±100 MHz.

3.3.3 Maintenance.

3.3.3.1 Scheduled maintenance. The GSU design shall require no scheduled maintenance, adjustment, or calibration other than mission set-up downloads.

3.3.3.2 Maintainability. The GSU shall not be supported as a repairable item, therefore, the GSU design is not required to accommodate hardware parts replacement due to failures. The GSU shall perform as specified herein after 10 years of storage when packaged in accordance with Section 5.

3.3.4 Reliability. The reliability of the GSU shall be as specified herein for the life cycle conditions provided in Table III.

TABLE III. GSU life cycle conditions.

Situation/Event	Maximum Accumulation
Storage/handling	10 years
Test range/handling/testing	10 hours
Captive carry (operating)	50 hours
Free flight (operating)	20 minutes
Catapulted launch and arrested landing	6 each total

3.3.4.1 Mean flight hours between failure. The GSU shall have predicted mean flight hours between failure (MFHBF) of no less than the following:

a. Captive-carry MFHBF of 2,611 hours.

b. Launch MFHBF of 1,660 hours.

c. Free flight MFHBF of 4,241 hours.

3.3.4.2 Operational reliability. The GSU shall be capable of operating continuously throughout a single mission that consists of a two hours duration captive carry and a 1,200 seconds duration free flight. The probability that the GSU functions as specified herein, throughout a single mission, shall be no less than 0.99 at a confidence level of not less than 0.95.

3.3.4.3 Operating life. The operating life of the GSU shall be no less than 100 hours. Operating life is the cumulative time during which power is applied to the GSU in all phases of testing, installation, and operation during captive carry and flight.

3.3.5 Safety.

a. The GSU shall be designed to present no hazards to personnel during handling, testing, or installation in the JTU.

b. The GSU shall be designed not to require special tools or handling to preclude damage to the GSU or JTU during installation and testing, except standard electrostatic discharge precautions.

3.3.6 Grounding, bonding, and shielding. The direct current resistance between all faying surfaces shall be no greater than 2.5 milliohms. The ground return path for all power and signal circuits shall be through wiring conductors in the wiring harness. The structure shall not be used as a current-carrying conductor, except that the RF ground path may be through the coaxial cable shields.

3.3.7 Electrical conductivity**.** Protective coatings on the GSU and its component mounting surfaces shall offer a low impedance path to RF currents. Mating surfaces to aluminum through which electrical bonding is required shall have metal-to-metal contact and be protectively finished to provide a resistance of not greater than 5,000 micro-ohms per square inch.

3.3.8 Electrostatic discharge. The GSU design shall provide electrostatic discharge protection for sensitive electrical and electronic circuitry in accordance with MIL-HDBK-263.

3.3.9 Interchangeability. All GSU's built to this specification shall be functionally and physically interchangeable.

3.3.10 Storage life. The GSU shall have a ten-year storage life.

3.3.11 Physical characteristics. While it is desirable the entire GSU function be contained within the form factor as shown in the ICD, Figure A2, the GSU function may be split into two modules to meet the Time to First Fix (TTFF) requirement. The airborne module shall meet the environmental and volume requirements of this specification. The ground based section shall be designed for a conditioned laboratory environment. The reliability of the ground based module, if required, shall be included as part of the complete GSU reliability. The maximum data transfer rate between the two modules shall be in accordance with A4.4.

3.3.11.1 Electrical and signal interfaces. The GSU shall provide connections for the electrical and signal interfaces, as specified in Appendix A.

3.3.11.2 Resonance. The lowest resonance frequency of the GSU shall be not less than 400 hertz (Hz).

3.3.11.3 Strength and rigidity. The GSU shall have a margin of safety for the specified design requirements. The GSU shall be designed to prevent yielding at limit load and to prevent failure at ultimate load. The limit load factor of safety shall be 1.0 and the ultimate load factor of safety shall be 1.5.

3.3.11.4 Marking. GSU marking shall be in accordance with the guidelines of MIL-STD-130K, Figure 1 call-outs 1, 3, 4, 6, 8, 10, and 12 and Figure 4a.

3.4 Performance characteristics. The GSU shall perform as specified herein when operating under the following conditions:

a. Operating from the voltage and power levels specified herein.

b. Operating from the data inputs as specified herein.

c. Operating with an L1 GPS signal as specified herein.

d. Operating under the flight dynamics, as specified herein.

e. When subjected to the environmental conditions or any combination of environmental conditions as specified herein.

f. When subjected to the electromagnetic interference (EMI) and electromagnetic compatibility (EMC) conditions as specified herein.

3.4.1 Voltage inputs to the GSU. The GSU shall perform as specified herein, when operating from the voltage input and power levels specified in Appendix A.

3.4.1.1 Warm-up time. The GSU shall operate, as specified herein, within 20 seconds when the applied input power attains the voltage range specified in Appendix A.

3.4.1.2 Input power quality. The GSU shall operate normally as specified herein, with a ripple voltage of up to 5 millivolts at any frequency from 10 Hz to 1 MegaHertz (MHz) imposed on all input power lines.

3.4.2 Data inputs to the GSU. Data input provisions for the GSU shall be as specified in Appendix A.

3.4.2.1 Event mark inputs. There are three discrete event mark input channels to the GSU. The GSU shall provide time stamps, T1, T2, and T3 for each of the event marks at the event mark ON time.

a. The GSU shall provide time stamps, T1, T2, and T3 for each of the event marks at the event mark ON time. These time stamps shall be inserted into the GSU's Missile Application Time Message (MATM) to the JTU.

b. At power-up, the three GSU time stamps T1, T2, and T3 shall be initialized to zero and remain so until the first occurrence of an event mark input.

c. The time stamp inaccuracy for any event mark input shall be no greater than 1.0 microseconds (μs) of the event ON time with respect to GPS time. This requirement may be met using post mission processing and applies to a flight time of at least 6 seconds.

d. The time stamp for each event mark shall remain latched until the next occurrence of an event mark input on that channel.

3.4.2.2. Programming Port. This port shall be an RS-232 serial port for programming and/or testing the GSU.

3.4.3 GPS operational requirements. The GSU shall accept GPS RF inputs at the L1 frequency of 1575.42 MHz. It shall acquire and track all satellites in view (up to 12) with a minimum carrier to noise in a 1 Hz bandwidth ratio (C/No) at the input of the GSU of 38 dB-Hz for acquisition and 35 dB-Hz at an RF level of -167 dBW for tracking. The GSU shall have a dynamic range sufficient to meet all tracking requirements anywhere on the earth to an altitude of 100,000 feet. The following performance requirements assume an input of -162 dBW and a minimum of four satellites tracked.

3.4.3.1 DELETED

3.4.3.2 Dual mode operation. If the GSU is implemented as two modules with an airborne module plus a ground module, provisions shall be made for dual mode operation as described in this paragraph. The GSU shall meet all requirements specified in this specification in either mode of operation unless specifically modified for the two-module implementation. The transition shall occur at the EPS boundary.

3.4.3.2.1 Sensor mode. The sensor mode shall refer to the mode in which the airborne GSU operates as a GPS sensor only. In this mode the GSU collects and sends the sampled GPS satellite data in a TUMS Type II format, via the JTU to the ground module. The data is then correlated and processed in the ground GSU module. This mode shall be the default mode of operation.

In the sensor mode the GSU shall output real-time coarse acquisition (C/A) code range measurement data in the form of Missile Application Condensed Measurements (MACM), MATM, Position, Velocity, Time Message (PVTM) from four or more GPS satellites beginning no later than 3 seconds after the GPS L1 input is visible to the GPS RF antenna. The definitions of MACM, MATM, and PVTM are defined in NAWC-CH 3132. This requirement shall apply from either a hot or cold GSU start. A cold start is defined as power-up with no prior information (almanac, ephemeris, time, or position). The GSU shall acquire all other available satellites (up to 12) within 7 seconds. The number of satellites being tracked is limited to 12 in order to stay within the TM bandwidth limitations.

3.4.3.2.1.1 Activation. The GSU shall output data in the sensor mode when any of the following is true:

a. The navigation mode is prevented by setting the mode pin to low.

b. DELETED

c. DELETED

3.4.3.2.1.2 Acceleration levels In the sensor mode the GSU shall be capable of code tracking and carrier phase measurements at acceleration levels up to 50g

3.4.3.2.1.3 Ground module processing. The JTU will combine GPS measurements from the GSU with inertial measurements and output a TSPI Unit Message Structure (TUMS) message to the vehicle telemetry system. The detail of the JTU processing is covered in the JTU Specification. The TUMS structure is a packetized protocol that is defined in NAWC-CH 3132 for both raw GPS measurements (Type II) and for processed GPS measurements in the MACM format as Type I. If the GSU is implemented in the dual mode option, the ground module shall perform additional processing as specified below when operating in the sensor mode. TUMS data shall be sent to the ground module via the air vehicle telemetry system and the ground telemetry receiving and distribution system. This module shall be capable of receiving and sending data via RS-232F and LAN IEEE 802.3 connections and protocol. The ground unit shall be designed using off-the-shelf components wherever possible

3.4.3.2.1.3.1 Ground module data input. Data shall be either TUMS Type II or in some cases TUMS Type I at a rate specified in the ordering information.

3.4.3.2.1.3.2 Data synchronization. The ground processor shall input either raw sensor GPS data or TUMS Type II as asynchronous serial data. If TUMS Type II data is input the IMU data words shall be buffered such that the original synchronization between the GPS measurements and the IMU measurements is maintained. This synchronization shall be maintained to within 100 microseconds.

3.4.3.2.1.3.3 Data archival. . The ground processing unit shall archive airborne GPS data for post mission phase recovery. This archiving shall record data for the length of the free flight (see 3.3.4) and shall use a PCMCIA RAM or flash RAM memory card that is accessible on the front of the unit (A.3.1.3.1). An external computer shall not be required for real-time data recovery and archival.

3.4.3.2.1.3.4 Data real-time output. The raw GPS data shall be processed to create a near realtime MACM, MATM, and PVTM messages solution containing all the data except carrier phase. These messages shall be output at the same rate as the original measurements and formatted into a TUMS Type I message with the buffered IMU measurements corresponding to that GPS measurement period in accordance with TUMS description in NAWC-CH 3132. This message shall be output to the JDP for navigation processing.

3.4.3.2.1.4 GSU reference receiver. The GSU ground module shall contain a GPS receiver that shall act as a reference station to provide differential corrections in real time. This receiver shall be capable of receiving and sending data via RS-232F and LAN IEEE 802.3 connections and protocol at a rate of not less than 10 messages per second. The LAN (PING) latency shall be less than 250 ms.

3.4.3.2.1.4.1 GPS reference receiver output. The internal reference receiver shall output ephemeris in a format as specified in the ordering information, MACM and contractor specific format data required for the ground processor. The total message rate shall not exceed 50 Kb/s.

3.4.3.2.1.4.2 Reference receiver input. There may be range installations where a GPS antenna connection is not available to the installation site of the GSU ground module. In this case the ground unit shall provide for GPS reference data input from the range reference receiver. This interface shall be via a LAN connection and shall provide both ephemeris data and MACM data.

3.4.3.2.2 Navigation mode. The navigation mode (or “full receiver” mode) shall refer to the mode in which all GPS processing is done in the airborne GSU module with the output of the MACM, MATM and PVT to the JTU. This shall be the secondary mode of operation and shall only be in activated as described herein.

3.4.3.2.2.1 Activation. The Navigation mode shall be activated with the mode pin is at a high level. The airborne unit shall transition from the sensor mode to the navigation mode after it has acquired ephemeris from five or more satellites. This transition shall take place in less than 41 seconds provided the airborne unit accelerations are less than 25 g and the input signal is –164 dBW or greater. Once the airborne unit transitions to the navigation mode it shall not transition back to the sensor mode.

3.4.3.2.2.2 Automatic de-activation . In the event that the number of phase tracking satellites drops below 4 as in 3.4.3.1, the unit shall transition to the sensor mode at the next epoch strobe.

3.4.3.3 Pseudorange. The GSU shall measure the pseudorange to each satellite being tracked with a maximum error 5 meters Root Mean Square (RMS) with a standard deviation of 1 meter**.**

3.4.3.4 Code range.. The GSU C/A code range measurement shall be formatted in MACM in accordance with NAWC-CH 3132 except that the carrier phase measurements are not required in real time.

3.4.3.5 Carrier phase measurements. The GSU shall measure the carrier phase to each satellite being tracked with a standard deviation of 30 millimeters RMS with a carrier to noise ratio of 38 dB-Hz. Post mission recover of carrier phase measurements is acceptable.

3.4.3.6 Position accuracy. The GSU shall provide position accuracy of <30 feet RMS in latitude, longitude, and altitude in real time with a PDOP of <=2.0.

3.4.3.7 Velocity accuracy. The GSU shall provide velocity accuracy of ≤3 feet/second in latitude, longitude, and altitude in real time.

3.4.4 Tracking dynamics. The GSU shall meet all the tracking requirements specified herein with the GPS signal level and environmental conditions specified herein.

3.4.4.1 Maximum velocity. The GSU shall provide GPS track, while operating continuously at velocities up to 5,000 feet per second.

3.4.4.2 Maximum acceleration. The GSU shall operate continuously and provide TSPI, while being exposed to maneuver accelerations of up to 50 gravity units (g) in all axes.

3.4.4.3 Maximum jerk. The GSU shall provide data and operate continuously, while being exposed to a jerk of 500 "g" per second for a 0.1 second duration.

3.4.4.4 Missile roll. The GSU shall provide data and operate continuously, while being exposed to roll rates of 15 revolutions per second, during missile maneuvers assuming rotation induced carrier phase changes (antenna phase center effects) do not exceed 22.5 degrees.

3.4.5 GSU voltage output. The GSU shall output voltage as specified in Appendix A.

3.4.6 GSU output data messages and signals. The GSU shall output data messages and signals as specified in Appendix A.

3.4.6.1 Message data. The GSU airborne unit shall output MATM, MACM, and PVTM when in the navigation mode and the ground processing unit shall insert MACM, MATM, and PVTM into the TUMS-1 message when in the sensor mode.

3.4.6.2 GSU status bit information. The GSU shall provide two status lines to indicate proper operation before and after being installed in a JTU. These status (ST) lines are identified as ST-1 and ST-2 in Appendix A.

a. ST-1 shall pulse low for 0.5 seconds once a second, while the GSU is tracking a minimum of four satellites.

b. ST-2 shall indicate the number of satellites being tracked. The first pulse (flash) shall be a long flash, followed by shorter flashes indicating the number of satellites being tracked. There shall be one short flash for each satellite. The duration and repetition rate of the flashes shall be adequate for a person to easily count.

c. ST-1 and ST-2 shall be capable of sinking 1 milliampere (ma).

3.4.6.3 Epoch pulse strobe. The GSU shall output an epoch pulse strobe (EPS), as specified in Appendix A.

3.4.6.4 Variable frequency output. The GSU shall output a variable frequency signal, as specified in Appendix A.

3.4.7 Standard conditions. The following conditions shall be used to establish normal performance characteristics under standard conditions and for making laboratory bench tests.

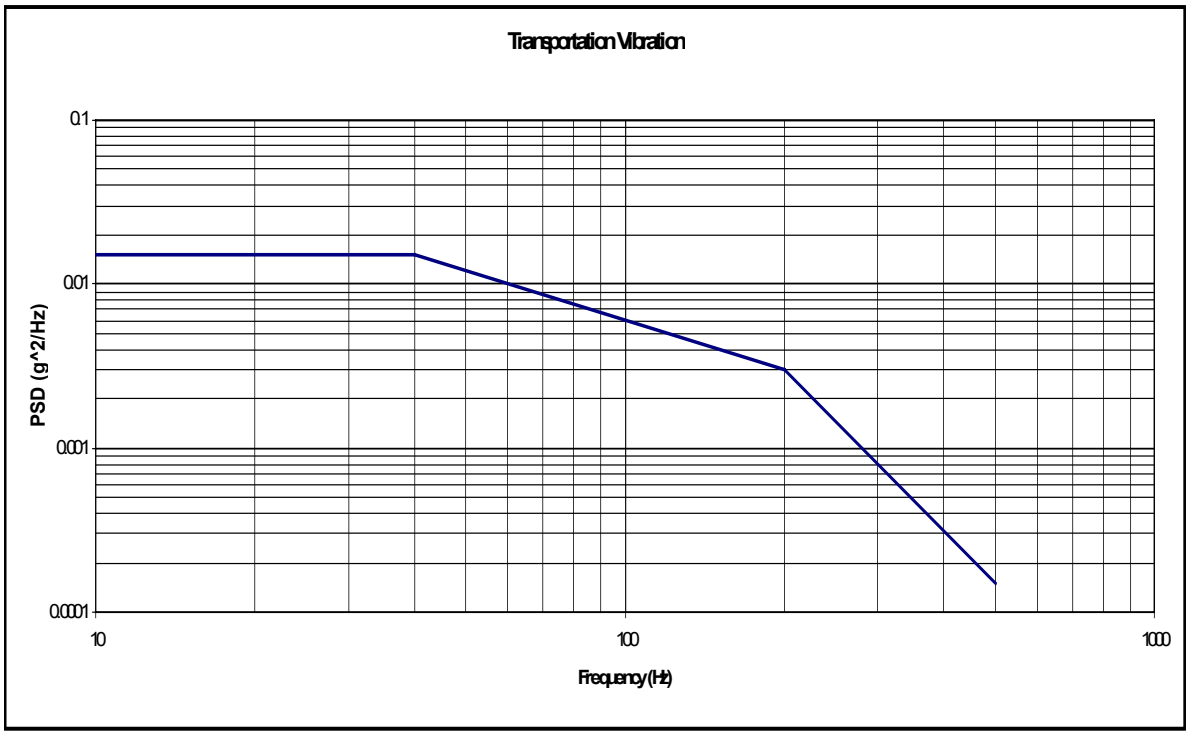
a.	Temperature	Room ambient, 25 ± 10 ^{o}C
b.	Altitude	Normal ground
c.	Vibration	None
d.	Humidity	Room ambient up to 95% relative humidity
e.	Input voltages	5.0 ± 2%, 100 ma maximum
		3.3 ± 2%, 700 ma maximum
		(Refer to Appendix A for GSU input voltages.)

3.4.8 Service conditions. The GSU shall perform as specified herein under any of the environmental conditions or combination of these conditions, as specified in 3.4.9.

3.4.9 Environmental conditions.

3.4.9.1 Vibration.

3.4.9.1.1 Transportation vibration. The GSU shall meet the performance requirements specified herein following exposure to the vibration profile shown on Figure 3. The transportation vibration test shall be performed in accordance with the levels, temperature, and time durations shown on Figure 3.



Breakpoints	
Frequency (Hz)	PSD (g^2/Hz)
10	0.015
40	0.015
200	0.003
500	0.00015
GRMS =1.27	

Notes:

For each axis:

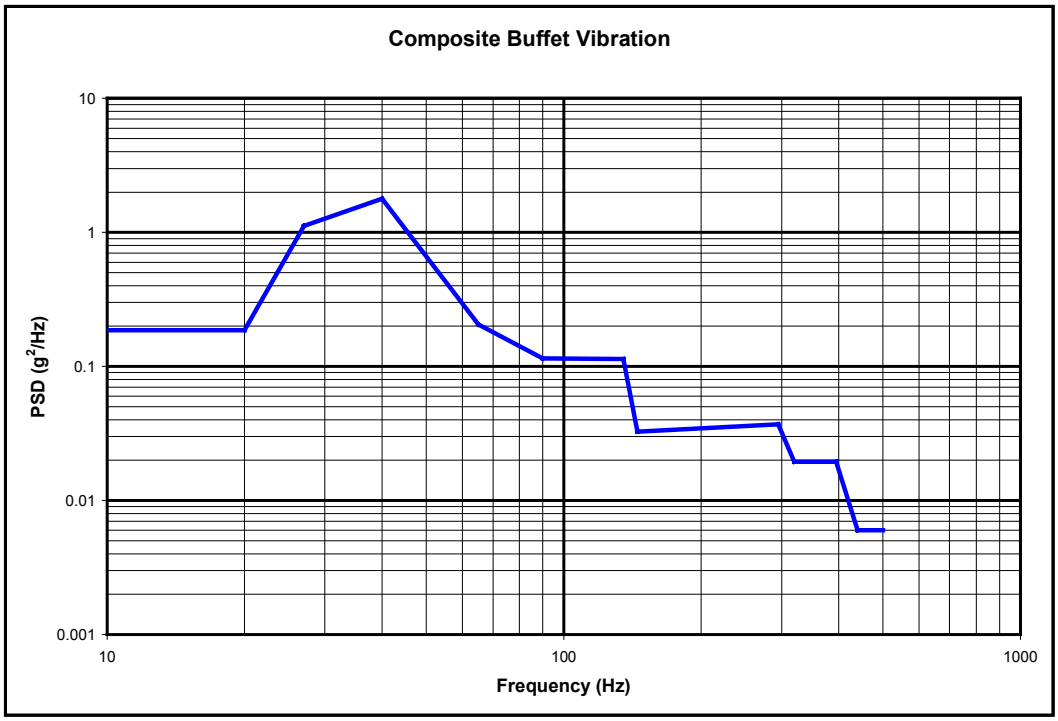
1 hour at -45ºC

1 hour at ambient

1 hour at +50ºC

FIGURE 3. Transportation Vibration

3.4.9.1.2 Composite buffet vibration. The GSU shall meet the performance requirements specified herein following exposure to the vibration profile shown on Figure 4. The composite buffet vibration test shall be performed in accordance with the levels, temperature, and time durations shown on Figure 4.



Breakpoints	
Frequency (Hz)	PSD (g^2/Hz)
10	0.1867
20	0.1867
27	1.1202
40	1.7785
65	0.2065
90	0.1147
135	0.1132
145	0.0327
295	0.037
320	0.0194
395	0.0194
440	0.006
500	0.006
GRMS = 7.67	

Notes:

For each axis:

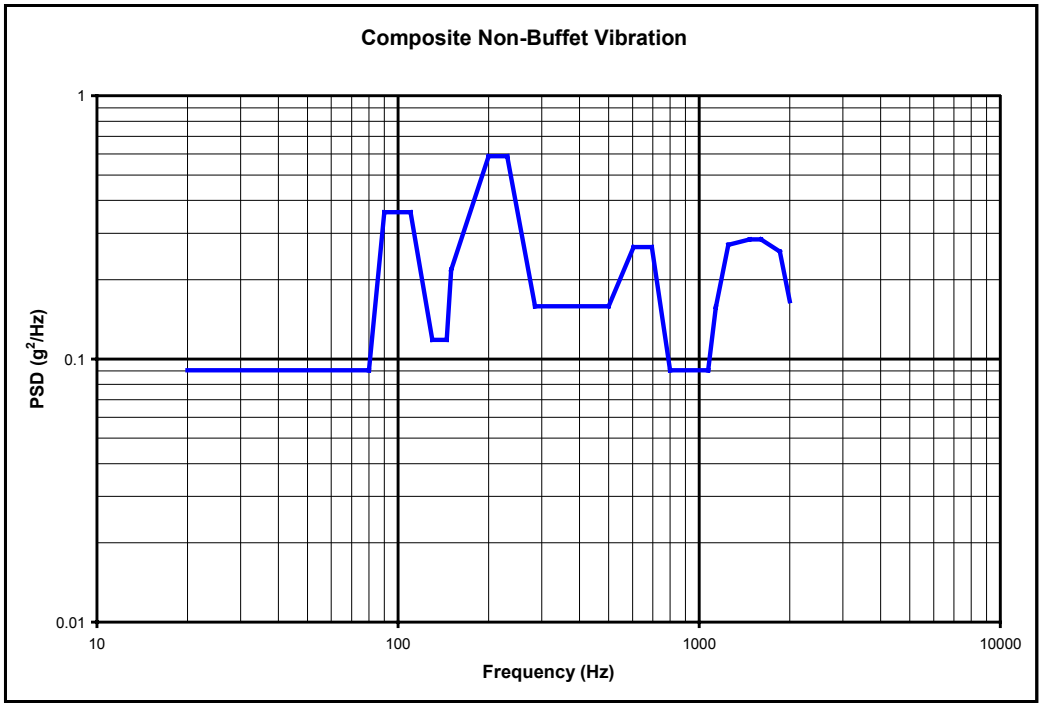
3 minutes at -40ºC

3 minutes at ambient

3 minutes at +85ºC

FIGURE 4. Composite Buffet Vibration

3.4.9.1.3 Composite non-buffet vibration. The GSU shall meet the performance requirements specified herein following exposure to the vibration profile shown on Figure 5. The composite non-buffet vibration test shall be performed in accordance with the levels, temperature, and time durations shown on Figure 5.



Breakpoints	
Frequency (Hz)	PSD (g^2/Hz)
20	0.0904
80	0.0904
90	0.3614
110	0.3614
130	0.1182
145	0.1182
150	0.2178
200	0.5887
230	0.5887
285	0.1583
500	0.1583
605	0.2661
695	0.2661
800	0.0904
1070	0.0904
1135	0.157
1250	0.2711
1470	0.2848
1605	0.2848
1850	0.2561
2000	0.1655
GRMS = 20.61	

Notes:

For each axis:

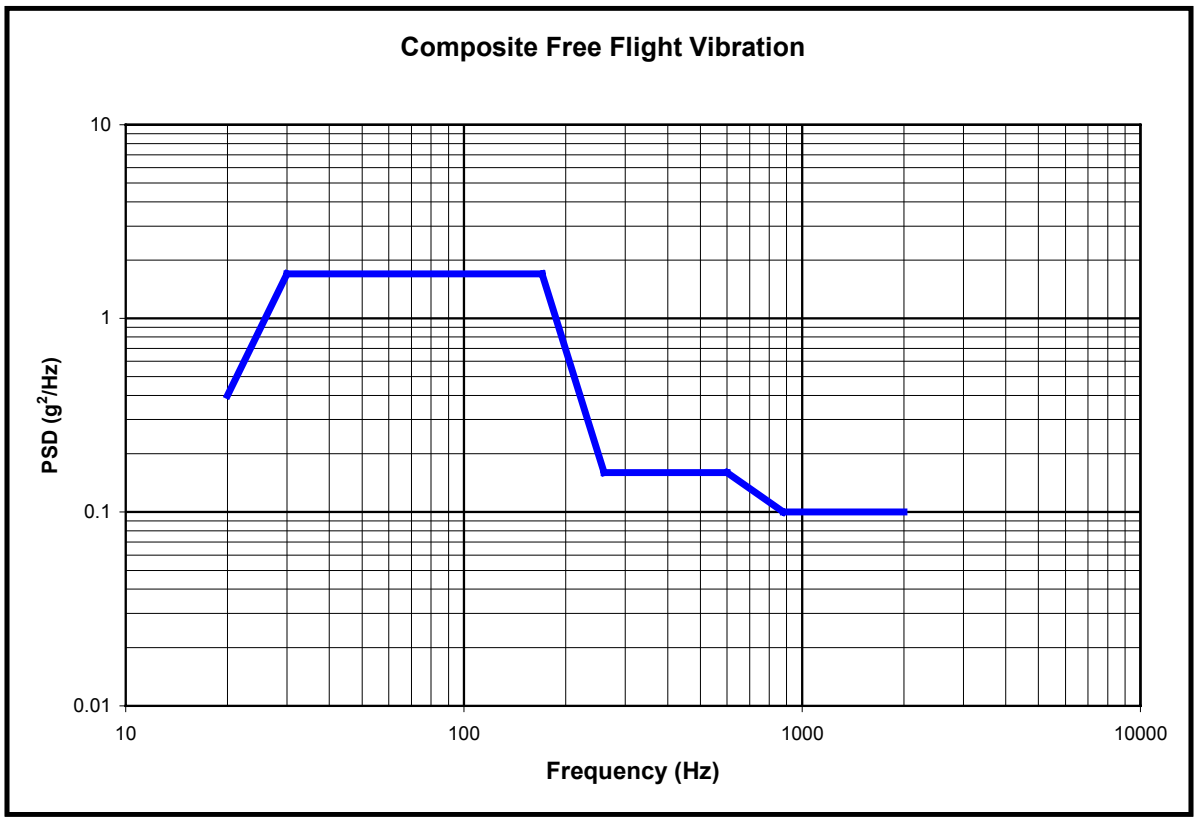
30 minutes at -40ºC

30 minutes at ambient

30 minutes at +85ºC

FIGURE 5. Composite Non-Buffet Vibration

3.4.9.1.4 Composite free flight vibration. The GSU shall meet the performance requirements specified herein during and following exposure to the vibration profile shown on Figure 6. The composite free flight vibration test shall be performed in accordance with the levels, temperature, and time durations shown on Figure 6.



Breakpoints	
Frequency (Hz)	PSD (g^2/Hz)
20	0.04
30	0.17
170	0.17
260	0.016
600	0.016
880	0.01
2000	0.01
GRMS = 7.09	

Notes:

For each axis:

20 minutes at -40ºC

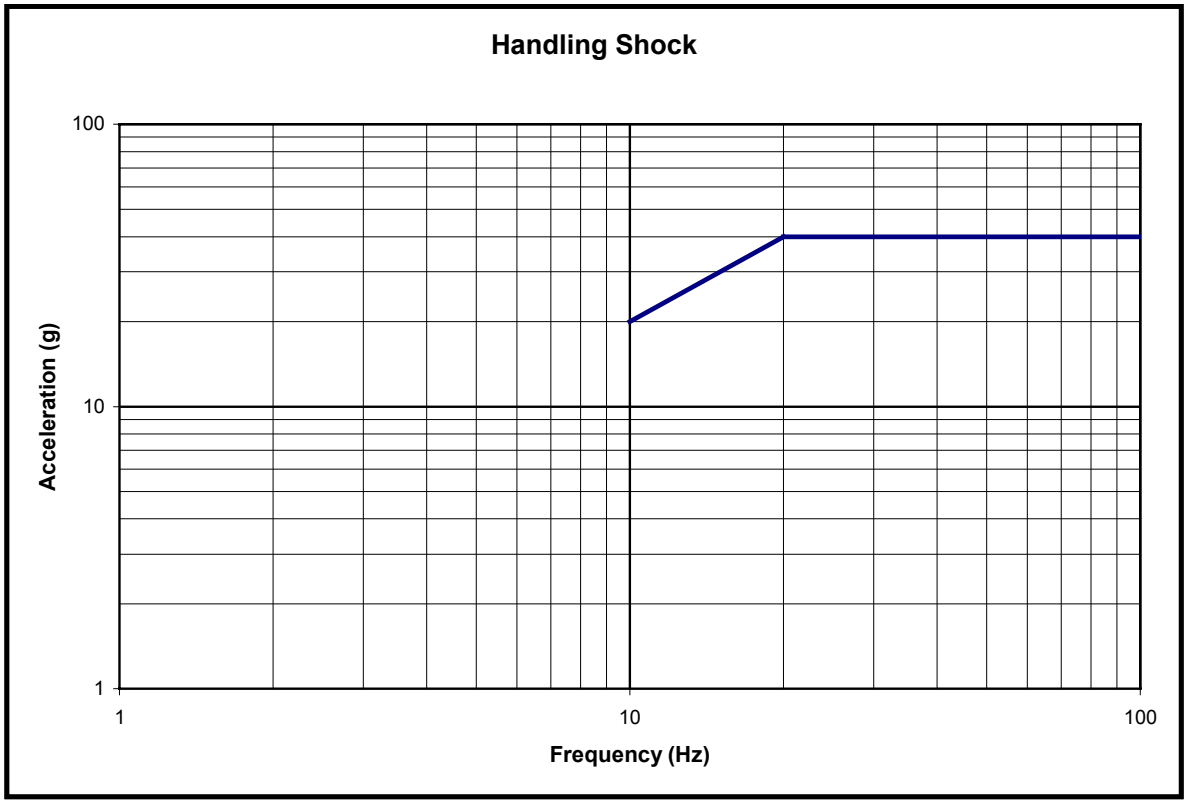
20 minutes at ambient

20 minutes at +85ºC

FIGURE 6. Composite Free Flight Vibration

3.4.9.2 Shock. Shock tests shall be performed at the high and low temperature extremes applicable to operating or non-operating conditions as specified herein.

3.4.9.2.1 Handling shock. The GSU shall meet the performance requirements specified herein following exposure to the vibration profile shown on Figure 7. The handling shock test shall be performed in accordance with the levels, temperature, and time durations shown on Figure 7.



Breakpoints	
Frequency (Hz)	Acceleration (g's)
10	20
20	40
100	40
Q=10	

Notes:

For each axis, each direction:

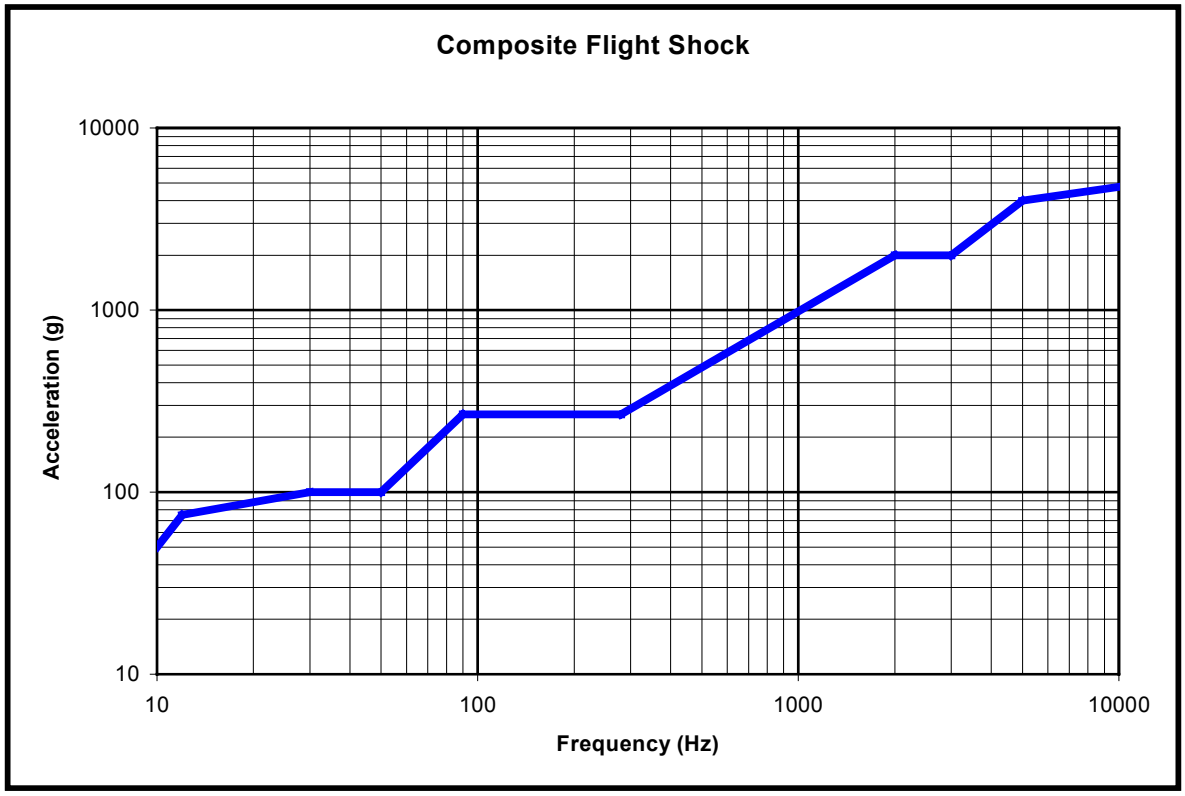
2 shocks at -45ºC

2 shocks at ambient

2 shocks at +50ºC

FIGURE 7. Handling Shock

3.4.9.2.2 Composite flight shock. The GSU shall meet the performance requirements specified herein during and following exposure to the vibration profile shown on Figure 8. The composite flight shock test shall be performed in accordance with the levels, temperature, and time durations shown on Figure 8.



Breakpoints	
Frequency (Hz)	**Acceleration (g)**
10	50
12	75
30	100
50	100
90	267.5
280	267.5
2000	2000
3000	2000
5000	4000
10000	4750
Q = 10	

Notes:

For each axis, each direction:

1 series at -40ºC

1 series at ambient

1 series at +85ºC

FIGURE 8. Composite Flight Shock

3.4.9.3 Acceleration. The GSU shall operate continuously, while being exposed to maneuver accelerations of up to plus and minus 50 "g" acceleration in all axes for 5 minutes.

3.4.9.4 Temperature.

3.4.9.4.1 Operating. The GSU shall meet the performance requirements specified herein during and after exposure to temperatures over the range of -40° to +85° Celsius (C).

3.4.9.4.2 Storage. The GSU shall be operational after exposure to a temperature range of -54° to +85° C.

3.4.9.4.3 Shock. The GSU shall meet the performance requirements specified herein after exposure to changes in ambient air temperature from -40° to 56° C in five minutes and from 56° to -40° C in five minutes.

3.4.9.5 Altitude. The GSU shall meet the performance requirements specified herein during and after exposure to altitudes over the range of sea level to 100,000 feet.

3.4.9.6 Altitude pressure rate change. The GSU shall meet the performance requirements specified herein during and after exposure to pressure rates of change equivalent to an ascent of 4,000 feet/second and a descent of 4,500 feet/second.

3.4.9.7 Humidity.

3.4.9.7.1 Operating. The GSU shall meet the performance requirements specified herein during and after exposure to relative humidity in the range of 1% to 98% over all the operating conditions specified herein.

3.4.9.7.2 Transportation and storage. During covered and ready storage the GSU shall withstand exposure to relative humidity in the range of 1% to 98% when cycled over the storage temperature specified in 3.4.9.4.2 and altitude range specified in 3.4.9.5.

3.4.9.8 Temperature, altitude, vibration, and humidity. The GSU shall meet the performance requirements specified herein during and after exposure to combinations of temperature, altitude, vibration, and humidity.

3.4.10 Electromagnetic interference control. The installation and integration of the GSU into the weapons system(s) electromagnetic environment shall cause no intra- or inter-electromagnetic incompatibility that results in degraded performance of the GSU or weapons systems in or on which the GSU is installed and operated. The generation of interference and the vulnerability of the GSU to interference shall be in accordance with MIL-STD-461 as modified herein. See Table IV.

TABLE IV. Electromagnetic interference requirements.

Parameter	Description, Limits, MIL-STD-461
CE 106	Conducted Emissions, Antenna Terminal, 10 kilohertz (KHz) to 40 GigaHertz (GHz).
CS103	Conducted Susceptibility, Antenna Port, Intermodulation 15 KHz to 40 GHz. The out of band signal levels used for CS103 shall be 66 dB above the threshold level of the receiver.
CS104	Conducted Susceptibility, Antenna Port, Rejection of Undesired Signals, 30 Hz to 20 GHz. Two signal method. The out of band signal levels used for CS104 shall be 80 dB above the level producing the standard reference output or zero dBm where real identifiable signals are shown to be present.
RE102	Radiated Emissions, Electric Field, 10 KHz to 18 GHz.

3.4.10.1 Magnetic fields. The GSU shall operate as specified herein during and after exposure to the following magnetic fields:

a. 1600 amperes per meter for a steady-state magnetic field.

b. 1600 amperes per meter per second for a changing magnetic field.

4.0 VERIFICATION

4.1 Inspections.

4.1.1 Classification of inspections.

a. Qualification inspection.

b. Conformance inspection.

4.1.2 Inspection methods. The methods of verification are analysis (A), demonstration (D), examination (E), and test (T) (see 6.3). A requirements-verification method cross-reference listing for all requirements is provided in Table V. Requirement verification procedures shall include the verification methods for the example, as marked in Table V. This listing may be subject to change based on, for example, applicability to the selected GSU design or the use of flight demonstration testing (see 6.2) in lieu of or in addition to analysis or to laboratory or bench testing.

4.1.3 Rejection criteria. Failure of the GSU to pass any of the tests specified herein shall be cause for rejection.

4.2 Qualification inspection. When specified in the contract or purchase order (see 6.2), qualification inspections shall be conducted on a number, as specified in the contract or purchase order (see 6.2), of GSU's representative of the production GSU's to be supplied under the contract. The qualification inspection shall consist of the inspection methods specified in Table VI and the inspection methods shall be performed in the sequence listed.

TABLE V. Requirements-verification method cross-reference.

Requirement Paragraph	Requirement	Verification method				
		n/a	A	D	E	T
3	REQUIREMENTS		X	X	X	X
3.1	Qualification sample (when specified in the contract)					X
3.2	Materials and parts		X		X	
3.2.1	Selection of materials and parts		X			
3.2.2	Parts stress derating		X			
3.3	Design		X	X	X	X
3.3.1	Interfaces				X	X
3.3.2	Voltage and radio frequency input protection					X
3.3.2.1	Voltage input					X
3.3.2.2	Radio Frequency power input					X
3.3.3	Maintenance				X	
3.3.3.1	Scheduled maintenance				X	
3.3.3.2	Maintainability				X	
3.3.4	Reliability		X	X		X
3.3.4.1	Mean flight hours between failure		X			X
3.3.4.2	Operational reliability		X			X
3.3.4.3	Operating life		X	X		
3.3.5	Safety				X	
3.3.6	Grounding, bonding, and shielding				X	
3.3.7	Electrical conductivity				X	
3.3.8	Electrostatic discharge		X		X	
3.3.9	Interchangeability				X	
3.3.10	Storage life		X			
3.3.11	Physical characteristics				X	X
3.3.11.1	Electrical and signal interfaces				X	
3.3.11.2	Resonance					X
3.3.11.3	Strength and rigidity				X	
3.3.11.4	Marking				X	
3.4	Performance characteristics		X	X		X
3.4.1	Voltage inputs to the GSU					X
3.4.1.1	Warm-up time					X

TABLE V. Requirements-verification method cross-reference.

Requirement Paragraph	Requirement	Verification method				
		n/a	A	D	E	T
3.4.1.2	Input power quality					X
3.4.2	Data inputs to the GSU					X
3.4.2.1	Event mark inputs					X
3.4.2.2	Programming port					X
3.4.3	GPS operational requirements					X
3.4.3.1	Time to first fix					X
3.4.3.2	Dual mode operation					X
3.4.3.2.1	Sensor mode					X
3.4.3.2.1.1	Activation					X
3.4.3.2.1.2	Acceleration levels					X
3.4.3.2.1.3	Ground module processing					X
3.4.3.2.1.3.1	Ground module data input					X
3.4.3.2.1.3.2	Data synchronization					X
3.4.3.2.1.3.3	Data real-time output					X
3.4.3.2.1.4	GSU reference receiver					X
3.4.3.2.1.4.1	GPS reference receiver output					X
3.4.3.2.1.4.2	Reference receiver input					X
3.4.3.2.2	Navigation mode					X
3.4.3.2.2.1	Activation					X
3.4.3.2.2.2	Automatic de-activation					X
3.4.3.3	Pseudorange					X
3.4.3.4	Code range measurements					X
3.4.3.5	Carrier phase measurements					X
3.4.3.6	Position accuracy					X
3.4.3.7	Velocity accuracy					X
3.4.4	Tracking dynamics					X
3.4.4.1	Maximum velocity					X
3.4.4.2.	Maximum acceleration					X
3.4.4.3.	Maximum jerk					X
3.4.4.4	Missile roll					X
3.4.5	GSU voltage output					X
3.4.6	GSU output data messages and signals					X

TABLE V. Requirements-verification method cross-reference.

Requirement Paragraph	Requirement	Verification method				
		n/a	A	D	E	T
3.4.6.1	Message data					X
3.4.6.2	GSU status bit information					X
3.4.6.3	Epoch pulse strobe					X
3.4.6.4	Variable frequency output					X
3.4.6.5	Pulse per second					X
3.4.7	Standard conditions	X				
3.4.8	Service conditions	X				
3.4.9	Environmental conditions					X
3.4.9.1	Vibration					X
3.4.9.1.1	**Transportation vibration**					X
3.4.9.1.2	**Composite buffet vibration**					X
3.4.9.1.3	**Composite non-buffet vibration**					X
3.4.9.1.4	**Composite free flight vibration**					X
3.4.9.2	Shock					X
3.4.9.2.1	Handling shock					X
3.4.9.2.2	Composite flight shock					
3.4.9.3	Acceleration					X
3.4.9.4	Temperature					X
3.4.9.4.1	Operating					X
3.4.9.4.2	Storage					X
3.4.9.4.3	Shock					X
3.4.9.5	Altitude					X
3.4.9.6	Altitude pressure rate change					X
3.4.9.7	Humidity					X
3.4.9.7.1	Operating					X
3.4.9.7.2	Transportation and storage					X
3.4.9.8	Temperature, altitude, vibration, and humidity					X
3.4.10	Electromagnetic interference control					X
3.4.10.1	Magnetic fields					X
5.	PACKAGING				X	
5.1	Packaging for acceptance delivery				X	

TABLE V. Requirements-verification method cross-reference.

Requirement Paragraph	Requirement	Verification method				
		n/a	A	D	E	T
5.2	Packaging for storage or other special packing				X	
A.1	General	X				
A.1.1	Scope	X				
A.1.2	System overview	X				
A.2	Applicable documents	X				
A.3	MECHANICAL INTERFACE DESCRIPTION				X	
A.3.1	GSU mounted in the JTU				X	
A.3.2	GSU form, fit, and mounting.				X	
A3.3	GSU ground unit configuration				X	
A3.3.1	GSU ground unit form, fit, and mounting				X	
A.4	ELECTRICAL AND SIGNAL INTERFACES				X	X
A.4.1	GSU interface to the GPS signal (J1)				X	
A.4.1.1	GSU J1 input and output					X
A.4.2	GSU data connector interface to the JTU				X	
A.4.2.1	Data connector pin assignments				X	
A.4.2.2	Data connector pin assignment definitions	X				
A.4.2.3	GSU data connector input and output					X
A.4.3	Power input					X
A.4.3.1	Supplied electrical power					X
A.4.3.2	Input power quality					X
A.4.4	Message data output					X
A.4.4.1	MATM					X
A.4.4.1.1	MATM format					X
A.4.4.2	MACM message					X
A.4.4.2.1	Deleted	X				
A.4.4.2.2	Deleted	X				
A.4.4.3	PVTM					X
A.4.4.3.1	PVTM format					X
A.4.5	Programming/test port					X
A.4.6	Serial data port					X
A.4.7	Status bits					X

TABLE V. Requirements-verification method cross-reference.

Requirement Paragraph	Requirement	Verification method				
		n/a	A	D	E	T
A.4.8	Epoch pulse strobe.					X
A.4.9	Event mark input.					X
A.4.10	Variable frequency output					X
A.4.11	Pulse per second output					X

TABLE VI. Qualification inspection.

Requirement Paragraph	Verification Requirement	Verification Method Paragraph(s)
	ANALYSIS	
3.2.1	Selection of materials and parts	4.2.2.1
3.2.2	Parts stress de-rating	4.2.2.1
3.3.4	Reliability	4.2.2.1
3.3.4.1	Mean flight hours between failure	4.2.2.1
3.3.4.2	Operational reliability	4.2.2.1
3.3.4.3	Operating life	4.2.2.1
3.3.8	Electrostatic discharge	4.2.2.1, 4.2.2.2.1
3.3.10	Storage life	4.2.2.1
	EXAMINATION	
3.2	Materials and parts	4.2.2.2
3.3.1	Interfaces	4.2.2.2
3.3.3.1	Scheduled maintenance	4.2.2.2
3.3.3.2	Maintainability	4.2.2.2
3.3.5	Safety	4.2.2.2
3.3.6	Grounding, bonding, and shielding	4.2.2.2
3.3.7	Electrical conductivity	4.2.2.2
3.3.8	Electrostatic discharge	4.2.2.2
3.3.9	Interchangeability	4.2.2.2
3.3.11	Physical Characteristics	4.2.2.2
3.3.11.1	Electrical and signal interfaces	4.2.2.2
3.3.11.3	Strength and rigidity	4.2.2.2
3.3.11.4	Marking	4.2.2.2
5.1	Packaging for acceptance delivery	4.2.2.2, 4.6
5.2	Packaging for storage or other special packing	4.2.2.2, 4.6
	TESTS	
3.3.1	Interfaces	4.2.2.3
3.3.2	Voltage and radio frequency input protection	4.2.2.3
3.3.2.1	Voltage input	4.2.2.3
3.3.2.2	Radio frequency power input	4.2.2.3

TABLE VI. Qualification inspection.

Requirement Paragraph	Verification Requirement	Verification Method Paragraph(s)
3.3.4	Reliability	4.2.2.3
3.3.4.1	Mean flight hours between failure	4.2.2.3
3.3.4.2	Operational reliability	4.2.2.3
3.3.11.2	Resonance	4.2.2.3, 4.2.2.5
3.4	Performance characteristics	4.2.2.3
3.4.1	Voltage inputs to the GSU	4.2.2.3
3.4.1.1	Warm-up time	4.2.2.3
3.4.1.2	Input power quality	4.2.2.3
3.4.2	Data inputs to the GSU	4.2.2.3
3.4.2.1	Event mark inputs	4.2.2.3
3.4.2.2	Programming test port	4.2.2.3
3.4.3	GPS operational requirements	4.2.2.3
3.4.3.1	Time to first fix	4.2.2.3
3.4.3.2	Dual mode operation	4.2.2.3
3.4.3.2.1	Sensor mode	4.2.2.3
3.4.3.2.1.1	Activation	4.2.2.3
3.4.3.2.1.2	Acceleration levels	4.2.2.3
3.4.3.2.1.3	Ground module processing	4.2.2.3
3.4.3.2.1.3.1	Ground module data input	4.2.2.3
3.4.3.2.1.3.2	Data synchronization	4.2.2.3
3.4.3.2.1.3.3	Data real-time output	4.2.2.3
3.4.3.2.1.4	GSU reference receiver	4.2.2.3
3.4.3.2.1.4.1	GPS reference receiver output	4.2.2.3
3.4.3.2.1.4.2	Reference receiver input	4.2.2.3
3.4.3.2.2	Navigation mode	4.2.2.3
3.4.3.2.2.1	Activation	4.2.2.3
3.4.3.2.2.2	Automatic de-activation	4.2.2.3
3.4.3.3	Pseudorange	4.2.2.3
3.4.3.4	Code range measurements	4.2.2.3
3.4.3.5	Carrier phase measurements	4.2.2.3
3.4.3.6	Position accuracy	4.2.2.3
3.4.3.7	Velocity accuracy	4.2.2.3

TABLE VI. Qualification inspection.

Requirement Paragraph	Verification Requirement	Verification Method Paragraph(s)
3.4.4	Tracking dynamics	4.2.2.3
3.4.4.1	Maximum velocity	4.2.2.3
3.4.4.2	Maximum acceleration	4.2.2.3
3.4.4.3	Maximum jerk	4.2.2.3
3.4.4.4	Missile roll	4.2.2.3
3.4.5	GSU voltage output	4.2.2.3
3.4.6	GSU output data messages and signals	4.2.2.3.
3.4.6.1	Message data	4.2.2.3
3.4.6.2	GSU status bit information	4.2.2.3
3.4.6.3	Epoch pulse stobe	4.2.2.3
3.4.6.4	Variable frequency output	4.2.2.3
3.4.6.5	Pulse per second	4.2.2.3
	EMI	
3.4.10	Eletromagnetic interface control	4.2.2.4
3.4.10.1	Magnetic fields	4.2.2.4.1
	ENVIRONMENTAL	
3.4.9.1	Vibration	4.2.2.6
3.4.9.1.1	Transportation vibration	4.2.2.6
3.4.9.1.2	Composite buffet vibration	4.2.2.6
3.4.9.1.3	Composite non-buffet vibration	4.2.2.6
3.4.9.1.4	Composite free flight vibration	4.2.2.6
3.4.9.2	Shock	4.2.2.6
3.4.9.2.1	Handling Shock	4.2.2.6
3.4.9.2.1	Composite flight shock	4.2.2.6
3.4.9.3	Acceleration	4.2.2.6
3.4.9.4	Temperature	4.2.2.6
3.4.9.4.1	Operating	4.2.2.6, 4.2.2.6.1
3.4.9.4.2	Storage	4.2.2.6, 4.2.2.6.1
3.4.9.4.3	Shock	4.2.2.6
3.4.9.5	Altitude	4.2.2.6
3.4.9.6	Altitude pressure rate change	4.2.2.6
3.4.9.7	Humidity	4.2.2.6

TABLE VI. Qualification inspection.

Requirement Paragraph	Verification Requirement	Verification Method Paragraph(s)
3.4.9.7.1	Operating	4.2.2.6
3.4.9.7.2	Transportation and storage	4.2.2.6
3.4.9.8	Temperature, altitude, vibration, and humidity	4.2.2.6, 4.2.2.6.2
	RELIABILITY	
3.1	Qualification sample (when specified in the contract)	4.2.2.7, 4.2.2.7.1

4.2.1 Qualification inspection approval. Approval of the qualification sample inspection shall be by the procuring activity upon satisfactory completion of all inspections. No production GSU's shall be delivered prior to approval of the qualification inspection. Prefabrication of production GSU's prior to approval of the qualification inspection shall be at the contractor's own risk. Disposition of qualification inspection samples shall be in accordance with the contract. The qualification inspection samples shall not be considered as one of the production GSU's under the contract.

4.2.2 Qualification inspection method. Test procedures shall be written for the qualification inspection and shall consist of the following:

a. Analysis of design and reliability prediction data.

b. Examination of the product.

c. Performance test.

d. Electromagnetic interference control test.

e. Environmental tests.

f. Reliability qualification test when required by the contract (see 6.2).

4.2.2.1 Analysis of design and reliability prediction data. Design and reliability prediction data required or developed under this specification shall be analyzed to ensure compliance with the requirements of this specification. The MFHBF requirements specified herein shall be verified using the prediction methodology of MIL-HDBK-217 with no stress ratios greater than 1.0.

a. The captive carry MFHBF shall be predicted using the MIL-HDBK-217 Airborne Uninhabited Attack environment and component temperatures that result from GSU worst case operating temperatures over a single mission duration.

b. The launch MFHBF shall be predicted using the MIL-HDBK-217 Missile Launch environment and component temperatures that result from GSU worst case operating temperatures over a single missile duration.

c. The free flight MFHBF shall be predicted using the MIL-HDBK-217 Missile Free Flight environment and component temperatures that result from worst case operating temperatures over a single mission duration.

4.2.2.2 Examination of the product. The GSU shall be examined to ensure that all product design requirements specified in Table V have been met.

4.2.2.2.1 Electrostatic discharge. The requirements of 3.3.8 shall be verified by analysis and examination using the guidelines of MIL-HDBK-263.

4.2.2.3 Performance.

a. Tests shall be conducted on the GSU to demonstrate that all interface and performance requirements specified in Table VI have been met.

b. When specified in the contract or purchase order (see 6.2), GSU compliance with all or selected requirements specified herein shall be verified with flight test demonstrations.

4.2.2.4 Electromagnetic interference control. Tests shall be conducted on the GSU in accordance with MIL-STD-461 for the GSU applicable class and type of equipment to verify compliance with 3.4.10 herein.

4.2.2.4.1 Magnetic fields. The GSU shall be tested to verify compliance with 3.4.10.1

4.2.2.5 Resonant frequency determination. Prior to any vibration testing specified herein (ESS Test), the item's resonant frequencies shall be determined. For resonant frequency determination by test, the output(s) shall be measured on compliant structure(s) of the test item where the maximum response(s) are anticipated. The frequencies can be described using modal equipment. If modal equipment is not used, then either sinusoidal (determined by varying the frequency of applied sinusoidal vibration through the range of 5-2,000-5 Hz at reduced levels, but with sufficient amplitude, to excite the item) or random inputs may be used.

4.2.2.6 Environmental.

a. GSU compliance with the requirements of 3.4.9 shall be verified in accordance with the applicable procedures of MIL-STD-810 tailored to meet the environmental levels and operational use of the GSU as specified herein.

b. Special test procedures shall be developed for those requirements of 3.4.9 for which MIL-STD-810 is not applicable.

4.2.2.6.1 Temperature testing.

a. For all operating temperature-related tests specified herein, the component mounting surface of the item shall be the location at which the test/soak temperature applies.

b. For non-operating (logistic) temperature tests specified herein, the temperature sensor shall be placed on an exposed side of the item in order to measure the temperature of the proximate surrounding air.

4.2.2.6.2 Temperature, altitude, vibration, and humidity. The GSU shall be tested under selected combinations of temperature, altitude, vibration and humidity over the following environmental ranges:

a. High temperature operating: +32 ^{o}C
b. Low temperature operating: -40 ^{o}C
c. Altitude: 100,000 feet maximum
d. Vibration: Refer to Figures 3 and 4
e. Humidity: 95%

4.2.2.7 Reliability qualification testing. When specified in the contract or purchase order (see 6.2), reliability qualification tests shall be conducted in accordance with the guidance of MIL-HDBK-781. Classification of the failures shall be in accordance with the guidance of MIL-HDBK-781. The test details such as the length of the test cycle, the number of test cycles, the performance characteristics to be measured, special failure criteria, and preventive maintenance to be allowed during the test shall be part of the test procedures (see 6.2) to be prepared prior to the beginning of the reliability qualification tests.

4.2.2.7.1 Reliability qualification test. At minimum, the contract specified (see 6.2) number of GSU's shall be tested and shall have passed in accordance with reliability test plan developed in accordance with the guidance of MIL-HDBK-781. For the qualification phase, the test level shall be:

a.	Temperature, cycling	-40^{o} to +70^{o}C, 8 cycles
b.	Vibration	10 minutes per axis of random vibration with the following spectral shape: Starting at 20 Hz, 0.0053 g^2/Hz with a slope of 3 dB/octave to 150 Hz; then, from 150-600 Hz at a level of 0.04 g^2/Hz; then dropping at 6 dB/octave to a level of 0.0036 g^2/Hz at 2,000 Hz.
c.	Altitude, cycling	0 to 100,000 feet, 8 cycles
d.	Input voltages	5 ± 2%, 100 ma maximum 3.3 ± 2%, 700 ma maximum
e.	GSU Power-0n	Power-on continuously

4.3 Conformance inspections. Procedures shall be written for conformance inspections and shall consist of the following:

a. Individual tests.

b. Reliability acceptance tests.

c. Special tests.

4.3.1 Individual tests. Each GSU submitted for acceptance shall be subjected to the individual inspection methods specified in Table VII and the inspection methods shall be performed in the sequence listed. These tests shall demonstrate compliance with the requirements of material, performance, and reliability. As a minimum, each GSU shall have passed the following tests:

a. Examination of the GSU.

b. Performance test.

TABLE VII. Individual inspection.

Requirement Paragraph	Verification Requirement	Verification Method Paragraph(s)
	EXAMINATION	
3.2	Materials and parts	4.3.1.1
3.3.5	Safety	4.3.1.1
3.3.6	Grounding, bonding, and shielding	4.3.1.1
3.3.7	Electrical conductivity	4.3.1.1
3.3.8	Electrostatic discharge	4.3.1.1
3.3.9	Interchangeability	4.3.1.1
3.3.11.1	Electrical and signal interfaces	4.3.1.1
3.3.11.3	Strength and rigidity	4.3.1.1
3.3.11.4	Marking	4.3.1.1
5.1	Packaging for acceptance delivery	4.3.1.1, 4.6
5.2	Packaging for storage or other special packing	4.3.1.1, 4.6
	TESTS	
3.3.1	Interfaces	4.3.1.2
3.3.2	Voltage and radio frequency input protection	4.3.1.2
3.3.2.1	Voltage input	4.3.1.2
3.3.2.2	Radio frequency power input	4.3.1.2
3.4	Performance characteristics	4.3.1.2
3.4.1	Voltage inputs to the GSU	4.3.1.2
3.4.1.1	Warm-up time	4.3.1.2
3.4.1.2	Input power quality	4.3.1.2
3.4.2	Data inputs to the GSU	4.3.1.2
3.4.2.1	Event mark inputs	4.3.1.2
3.4.2.2	Computer display unit port	4.3.1.2
3.4.3	GPS operational requirements	4.3.1.2
3.4.3.1	Time to first fix	4.3.1.2
3.4.3.2	Dual mode operation	4.3.1.2
3.4.3.2.1	Sensor mode	4.3.1.2
3.4.3.2.1.1	Activation	4.3.1.2
3.4.3.2.1.2	Acceleration levels	4.3.1.2

TABLE VII. Individual inspection.

Requirement Paragraph	Verification Requirement	Verification Method Paragraph(s)
3.4.3.2.1.3	Ground module processing	4.3.1.2
3.4.3.2.1.3.1	Ground module data input	4.3.1.2
3.4.3.2.1.3.2	Data synchronization	4.3.1.2
3.4.3.2.1.3.3	Data real-time output	4.3.1.2
3.4.3.2.1.4	GSU reference receiver	4.3.1.2
3.4.3.2.1.4.1	GPS reference receiver output	4.3.1.2
3.4.3.2.1.4.2	Reference receiver input	4.3.1.2
3.4.3.2.2	Navigation mode	4.3.1.2
3.4.3.2.2.1	Activation	4.3.1.2
3.4.3.2.2.2	Automatic de-activation	4.3.1.2
3.4.3.3	Pseudorange	4.3.1.2
3.4.3.4	Code range measurements	4.3.1.2
3.4.3.5	Carrier phase measurements	4.3.1.2
3.4.3.6	Position accuracy	4.3.1.2
3.4.3.7	Velocity accuracy	4.3.1.2
3.4.5	GSU voltage output	4.3.1.2
3.4.6	GSU output data messages and signals	4.3.1.2.
3.4.6.1	Message data	4.3.1.2
3.4.6.2	GSU status bit information	4.3.1.2
3.4.6.3	Epoch pulse stobe	4.3.1.2
3.4.6.4	Variable frequency output	4.3.1.2
3.4.6.5	Pulse per second	4.3.1.2
	RELIABILITY	
3.3.4	Reliability	4.3.2

4.3.1.1 Examination of GSU. Each GSU shall be examined to determine that the material and workmanship requirements have been met.

4.3.1.2 Performance test.

a. Tests shall be conducted on the GSU to demonstrate that all performance requirements specified in Table VI have been met.

b. These tests are to be conducted under the standard conditions specified in 3.4.7.

4.3.2 Reliability acceptance test. Each GSU produced, except those submitted for the reliability qualification test, shall be tested for a predetermined number of failure-free hours of operating time. The number of failure free hours shall be based on the reliability requirements specified herein. The test level shall be the same as for the reliability qualification test. Prior to the failure-free testing, a burn-in period may be used. If the burn-in period is used, the details thereof shall be included in the test procedures (see 6.2). To determine whether the MFHBF and the operational reliability specified herein are being met at any time during the contract, the operating test hours and the failures thereon, not counting burn-in failures or burn-in operating time, shall be totaled and the results compared with the accept-reject criteria curve developed per the guidance of MIL-HDBK-781. These totals shall accumulate so that at any one time the experience from the beginning of the contract is included. The procuring activity shall be notified any time that the current totals of test hours and test failures plotted on the curve show a reject situation. The procuring activity reserves the right to stop the acceptance of GSU's at any time that a reject situation exists, pending a review of the contractor’s efforts to improve the GSU, the GSU parts, the GSU workmanship, and any other factors of the GSU’s makeup, so that the entire compilation shall show other than a reject situation.

4.3.3 Special tests. Special tests shall be conducted for the purpose of checking the effect of any design or material change on the performance of the GSU and to ensure adequate quality control. Selection of GSU's for special tests shall be made as follows:

a. On any GSU after a material or design change.

b. Whenever failure reports or other information indicates, as determined by the procuring activity, that special tests are required.

The scope of special tests shall consist of those tests as required by the procuring activity. Test procedures previously approved shall be used where applicable.

4.4 Production GSU's. GSU's supplied under the contract shall in all respects, including design, construction, workmanship, performance, and quality, be equal to the approved qualification samples. Each GSU shall be capable of passing the same tests imposed on the first article. Evidence of noncompliance with this requirement shall constitute cause for rejection and, for GSU's already accepted by the government, it shall be the obligation of the contractor to make the necessary corrections.

4.5 Presubmission testing. No item, part, or complete GSU shall be submitted to the government by the contractor until it has been previously tested and inspected in accordance with the test requirements herein and found to comply with the applicable requirements.

4.6 Inspection of packaging. The requirements of Section 5 shall be verified by examination.

5.0 PACKAGING

5.1 Packaging for acceptance delivery. The GSU packaging for delivery to and acceptance by the government shall be as specified in the contract.

5.2 Packaging for storage or other special packing.

a. If the GSU design requires special packaging provisions to meet the GSU storage environment requirements or storage life specified herein, a list of packaging materials, sources for the packing materials, and any special equipment to accomplish the packaging along with estimated costs to accomplish the packaging per unit shall be submitted for approval before the GSU design is finalized (see 6.2).

b. If special packaging is required, detailed packaging instructions, list of materials, and sources for the materials shall be provided with each GSU.

c. Any such special packaging shall be in addition to, and inside the packing required for delivery.

6.0 NOTES

This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.

6.1 Intended use. The JAMI program has been tasked to develop a system that will be used to provide missile position, velocity, attitude, and a vector score. The GSU will be installed in the JTU and then into a missile to provide vector position for TSPI and scoring. The sensors to provide missile attitude will be installed separate from this task. The JTU will be used to track missiles during live-fire tests. The JTU may also be installed in targets to provide target position and attitude. This information is required to determine missile position and attitude relative to the target. The design, implementation, fabrication, and verification of this performance specification are within the purview of the contractor while complying with the requirements/parameters identified in this document are met.

By using GPS to derive position information, missiles will no longer be required to stay within line of sight of radar systems. Mission participants will be able to operate “over-the-horizon”, restricted only by the ability to relay data to the ground, through an aircraft or other means.

The GSU will provide very rapid acquisition of the GPS satellites and position information on the missile for range safety purposes. It will also provide carrier phase data for post-mission processing analysis for vector scoring using a kinematics carrier-phase tracking processor.

6.2 Acquisition requirements. Acquisition documents should specify the following as applicable:

a. Title, number, and date of this specification.

b. Identify data source for GSU form, fit, and mounting requirements if other than Appendix A (see 3.3.11.1 and A.3.1).

c. Requirement for qualification sample inspection (see 3.1 and 4.2).

d. Mean flight hours between failure and reliability prediction analysis report (see 3.3.4, 3.3.4.1, 3.3.4.2, 3.3.4.3, 4.2.2.1)

e. Number of qualification inspection samples required (see 4.2).

f. Disposition of qualification inspection samples (see 4.2.1).

g. Test procedures (see 4.2.2, 4.3, 4.3.3).

h. Test reports (see 4.2.2, 4.3, 4.3.3).

i. Reliability acceptance test plan (see 4.2.2.7.1).

j. Requirement for reliability qualification testing (see 4.2.2.7).

k. Number of GSU's to be subjected to reliability qualification testing (see 4.2.2.7.1).

l. Packaging requirements for delivery (see 5.1).

m. Special packaging provisions (see 5.2).

n. The message output rate for MACM, MATM, and PVTM shall be specified in the ordering information (see 3.4.3.1.2, A.4.4.1, A.4.4.2, A.4.4.3).

o. The epoch pulse rate shall be specified in the ordering information (see 3.4.6.3).

p. The variable frequency pulse rate shall be specified in the ordering information (see 3.4.6.4).

q. The TUMS-2 input rate and the TUMS-1 output rate of the ground processor shall be specified in the ordering information (see 3.4.3.2.1).

6.3 Abbreviations and acronyms.

A	Analysis
ASCII	American Standard Code Information Interchange
BIT	Built in Test
C	Celsius
C/A	Coarse Acquisition
CDU	Computer Display Unit
cm	Centimeters
CMOS	Complimentary Metal Oxide Silicon
D	Demonstration
dB	Decibel
DCE	Data Communication Equipment
E	Examination
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EPS	Epoch Pulse Strobe
"g"	Acceleration in gravity units
GHz	GigaHertz
GPS	Global Positioning System
GSU	GPS Sensor Unit
Hz	Hertz
ICD	Interface Control Document
JAMI	Joint Advanced Missile Instrumentation
JTU	JAMI TSPI Unit
KHz	Kilohertz
ma	Milliampere
MACM	Missile Application Condensed Measurements
MATM	Missile Application Time Message
MHz	MegaHertz
ms	Millisecond
MFHBF	Mean Flight Hours Between Failure
pps	Pulse Per Second

PRN	Pseudorandom Noise
PSRNGE	Pseudorange
PVTM	Position, Velocity, Time Message
RF	Radio Frequency
RMS	Root Mean Square
SMA	Sub Miniature A
ST	Status
SVN	Satellite Vehicle Number
T	Test
TM	Telemetry
TSPI	Time-Space-Position Information
VDC	Volts Direct Current
μs	Microseconds
Analysis	Verification by analysis shall consist of the review and discussion of test and /or analytical data; performance of technical or mathematical evaluation; use of mathematical models or simulations; or review of algorithms, charts, or circuit diagrams.
Demonstration	Verification by demonstration shall be accomplished by using qualitative procedures including operation, adjustment, or reconfiguration of items performing their design functions under specific scenarios that verify compliance with the specified requirements.
Examination	Verification by examination shall be accomplished by a visual inspection of the item, reviewing descriptive documentation, and comparing the appropriate characteristics with predetermined standards to determine conformance to requirements without the use of laboratory equipment or procedures. Examination may include documents, the comparison of documents, or comparison of a document to the equipment or item it describes.
Test	Verification by test shall consist of a quantitative indication of compliance with specified requirements and shall be accomplished through systematic exercising of the item under appropriate conditions and the collection and evaluation of quantitative data.

6.4 Electromagnetic compatibility and electromagnetic interference. While compliance with the EMC and EMI requirements of this specification is the sole responsibility of the contractor, acquisition documents should clearly delineate the responsibilities between the government and the contractor and the methods to be used in verifying compliance with the EMC and EMI requirements of this specification.

The GSU shall be operated as an integral part of the JTU installed in various missile types which are carried and launched from Air Force, Army, and Navy launch platforms. There are many potential sources of interference signals from the missile, aircraft, and other sources such as an aircraft carrier for Navy aircraft. The lists presented in Tables VIII and IX are representative only, not all-inclusive, of the RF equipment operated aboard Air Force and Navy fighter aircraft.

TABLE VIII. Representative RF equipment on Air Force aircraft.

Equipment	F-15A/B	F-15C/D	F-15E	F-16A/B	F-16C/D
Radar Altimeter			APN-232	APN-232	APN-232
ECM[a] Equipment	ALQ-119 ALQ-135	ALQ-131 ALQ-135	ALQ-119 ALQ-135	ALQ-131 QRC-80-1	ALQ-131 ALQ-165
TACAN[b]	ARN-118	ARN-118	ARN-118	ARN-118	ARN-118
Radar	APG-63	APG-63 APG-70	APG-70	APG-66	APG-68
MLS[c]				MLS-3	MLS-3
IFF[d] Transponder	APX-101	APX-101	APX-101	APX-101 APX-109	APX-101
IFF Interrogator	APX-76	APX-76	APX-76	MARK XIT	
Radar Beacon					
ILS[e]	ARN-112	ARN-112	ARN-112	ARN-108	ARN-108
HF[f] Radio	ARC-190	ARC-190		ARC-200	
GPS Receiver	ARN-151	ARN-151	ARN-151	ARN-151	ARN-151
JTIDS[g]		URC-107		URC-107	URC-107
UHF[h] Radio	ARC-109 ARC-164 VRC-126	ARC-164 VRC-126	ARC-164 VRC-126	ARC-164 VRC-126	ARC-164 VRC-126
VHF[j] Radio				VRC-186	VRC-186
Auto Target Handoff System				CP1516/ASQ IDM	IDM
Radar Warning Receiver	ALR-56A ALQ-128	ALQ-128 ALR-56A ALR-56C	ALR-56C ALQ-128	ALR-69	ALR-56M ALR-69
Auto Direction Finder	OA-8639/ARA	OA-8639/ARA	OA-8639/ARA	OA-8639/ARA	OA-8639/ARA

a - Electronic Countermeasures

b - Tactical Air Navigation System

c - Microwave Landing System

d - Identification Friend or Foe

e - Integrated Landing System

f - High Frequency

g - Joint Tactical Information Distribution System

h - Ultra High Frequency

j - Very High Frequency

TABLE IX. Other RF systems.

System	Frequency (MHz)	Power (Watts)	Comments
TM	2200 - 2390	1 to 10	Uses same antenna as GSU on AMRAAM[a] AIU[b]
ARDS[c] Pod	1350 – 1435	80	Can be located about four inches from GPS antennas on launch aircraft. Also located on target aircraft.
GRDCS[d] Shooter Pod	915	300	Can be located about four inches from GPS antennas on launch aircraft. Also located on target aircraft.
Radar Beacon	5400 - 5900	50	Uses same antenna as GSU on AMRAAM AIU

a - Advanced Medium Range Air-to-Air Missile

b - Airborne Instrumentation Unit

c - Advanced Range Data System

d - Gulf Range Drone Control

APPENDIX A
GLOBAL POSITIONING SYSTEM SENSOR UNIT
INTERFACE CONTROL
DOCUMENT

A.1.0 SCOPE

This Appendix is the ICD for the JAMI GSU. It specifies the GSU mechanical and electrical interface requirements. This appendix is a mandatory part of the specification. Unless otherwise specified herein, the information contained herein is intended for compliance.

A.1.1 System overview. The GSU is mounted internal to the JAMI JTU and is interfaced to a telemetry (TM) RF data link through the JTU. The TM data link, in turn, relays GSU originated messages to a ground station, which produces real-time and post-mission missile position information. Figure A.1 provides a GSU-to-JTU interface illustration. The GSU output messages to the TM data link are MACM, MATM, and PVTM.

A.2.0 APPLICABLE DOCUMENTS

A.2.1 Non-Government publication. The following document forms a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are ODO adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents listed in the dodiss are the issues of the documents cited in the solicitation.

Electronics Industries Association (EIA)

EIA RS-232-F October 1997	Interface Between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Interchange with Application

(Application for copies should be addressed to Electronics Industries Association, 2001 Pennsylvania Ave., N.W.., Washington, D.C. 20006.)

A3.0 REQUIREMENTS

A.3.1 Mechanical interface description

A.3.1.1 GSU mounted in the JTU. The GSU shall be mounted internal to the JTU with the GSU GPS antenna connector serving as JTU J1. Refer to Figure A.2 for the proposed outline dimensions of the GSU.

A.3.1.2 GSU form, fit, and mounting. Unless otherwise specified in the contract (see 6.2), the GSU shall comply with the form, fit, and mounting provisions specified on Figure A.2.

A.3.1.3 GSU ground unit configuration. If the GSU is implemented as an airborne unit and a ground based unit, the airborne unit shall conform to the requirements of paragraphs A.3.2.1 through A.3.2.3. The message data output defined in A.3.2.4 may be output from the ground unit.

A.3.1.3.1 GSU ground unit form, fit, and mounting. The ground unit shall be configured to fit within a standard 19 inch rack mount 1.75 inch slot. The unit shall be powered from standard laboratory power. The location of status indicators, connectors, power switches, etc, are not critical but shall be coordinated with the government.

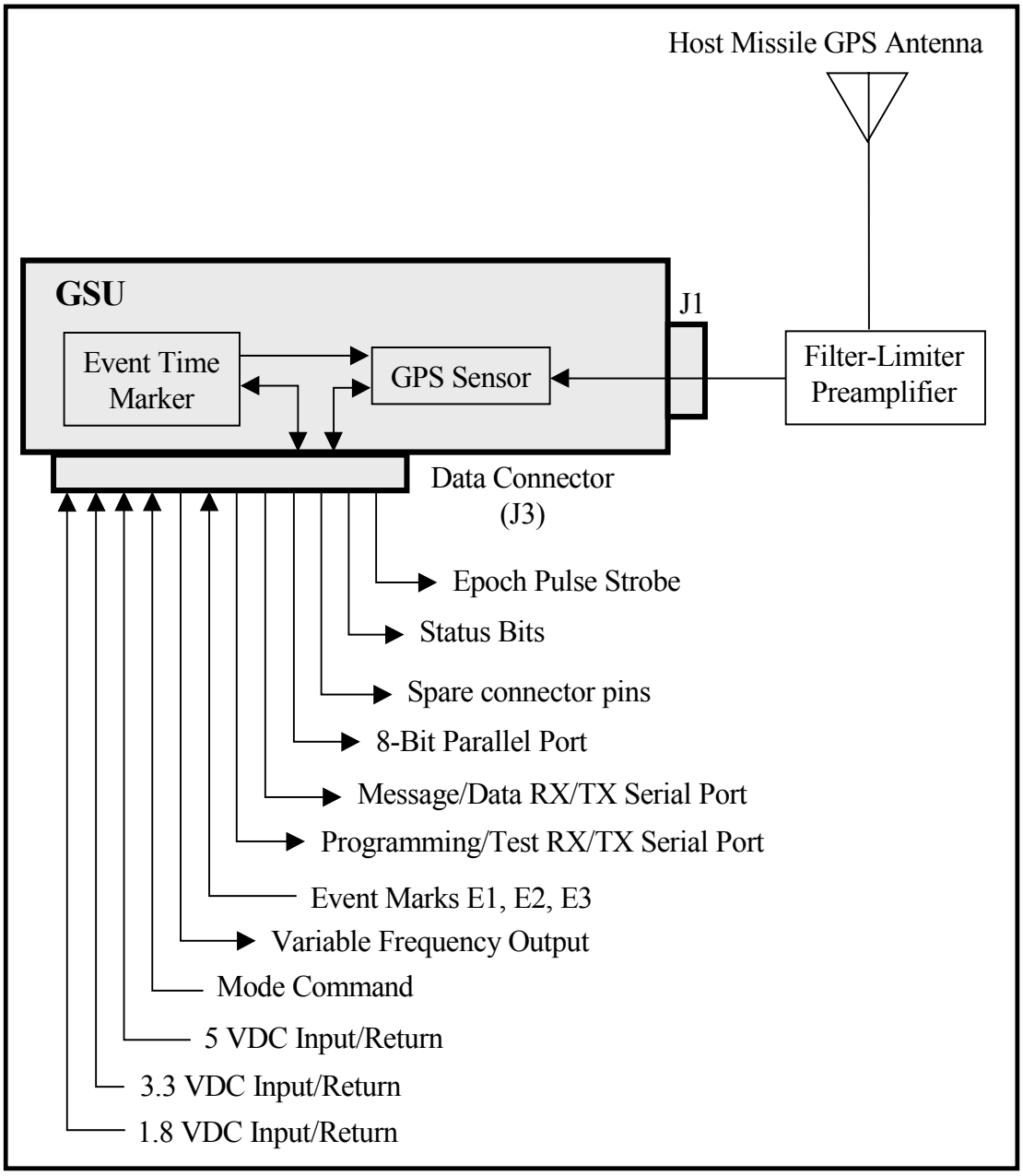


FIGURE A.1. GSU-to-JTU interface illustration.

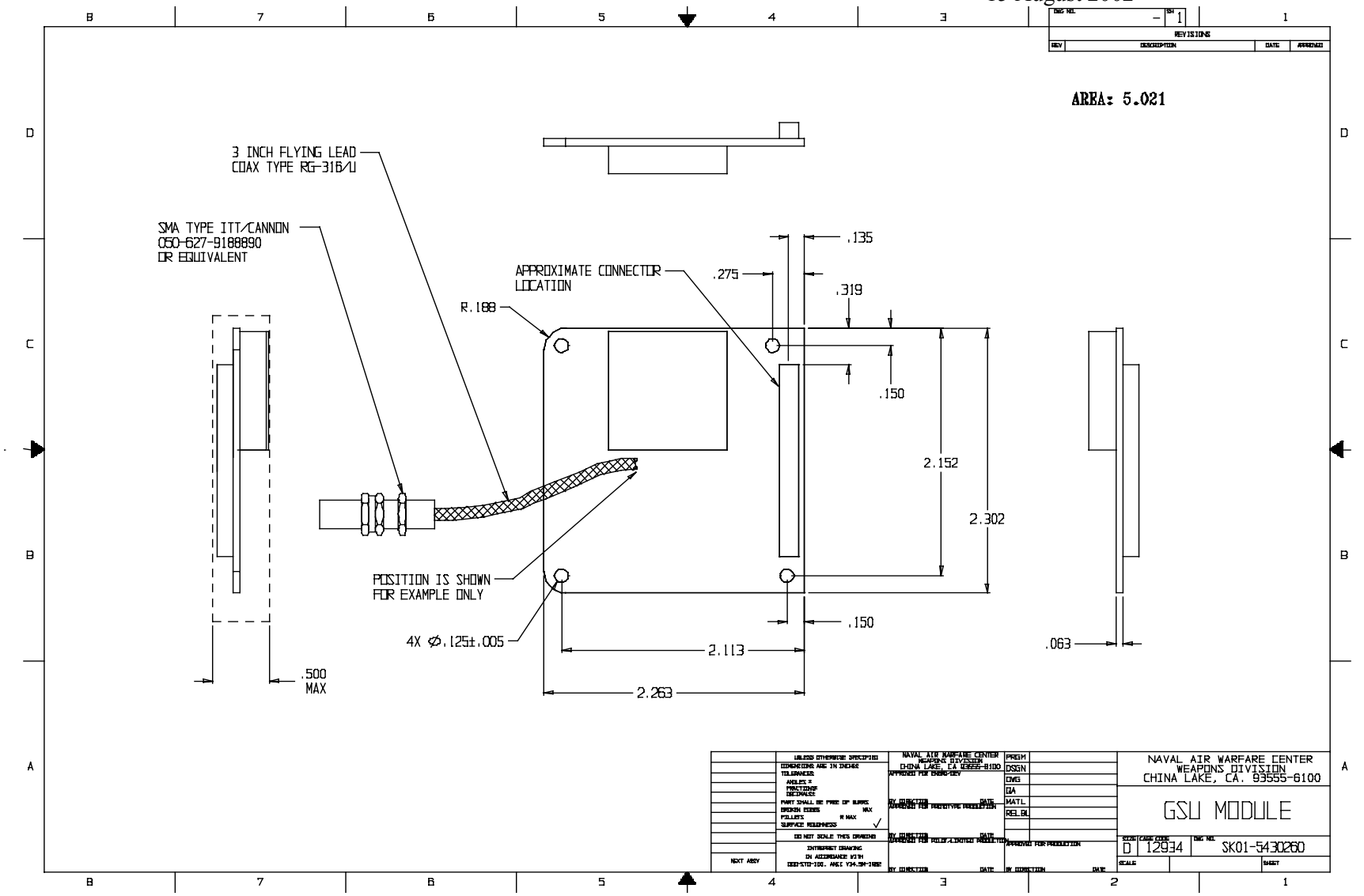


FIGURE A.2. GSU dimensions.

A.3.2 Electrical and signal interfaces. The GSU shall provide electrical and signal interfaces as specified herein.

A.3.2.1 GSU interface to the GPS signal.

a. The GSU module shall provide a 3 inch flying lead coax type RG-316/U connection with a SMA type ITT/Cannon 050-627-9188890 or equivalent."

b. The RF input impedance shall be 50 ohms nominal.

A.3.2.1.1 GSU J1 input and output.

a. The GSU shall route 5 ± 2% volts direct current (VDC) power at 100 ma maximum from the data connector (Figure A.1), pin 1 via the SMA connector (J1) center conductor to the filter-limiter-preamplifier assembly. The filter-limiter-preamplifier assembly and GPS antenna are shown on Figure A.1. The associated cabling between J1, the filter-limiter-preamplifier assembly, and the GPS antenna are components of the host missile.

b. The GPS signal input to the GSU J1 from the filter-limiter-preamplifier is specified in 3.4.3.

A.3.2.2 GSU data connector interface to the JTU. The GSU shall provide a highly reliable 36-pin data connector for interfacing to the internal JTU data connector. The GSU connector shall be a SAMTEC, SMM-118-01-S-D-36 or equivalent.

A.3.2.2.1 Data connector pin assignments. GSU data connector pin assignments shall be in accordance with Table A.I.

TABLE A.I. GSU interface data connector pin assignments.

Pin #	Name	Pin #	Name	Pin #	Name	Pin #	Name	Pin #	Name	Pin #	Name
1	Power +5 VDC	7	S5	13	RXDX1	19	ST2	25	D2	31	D8
2	S1	8	VARF	14	Power +1.8VDC	20	EPS	26	D3	32	S7
3	Mode	9	E1	15	TXD2	21	S3	27	D4	33	D9 CHIP_SEL
4	GND	10	E2	16	RXD2	22	S4	28	D5	34	D10 BLK_XFR
5	GND	11	E3	17	S6	23	Power +3.3 VDC	29	D6	35	D11 DAT_STB
6	S2	12	TXDX1	18	ST1	24	D1	30	D7	36	Key

Notes:

TXD1/RXD1 shall be a programming/test serial port.

TXD2/RXD2 shall be the serial data port.

A.3.2.2.2 Data connector pin assignment definitions. GSU data connector pin assignment definitions are provided in Table A.II.

TABLE A.II. GSU data connector signal definitions.

Name	Definition
PWR	Input power
GND	Ground/power return, all grounds connected on card
VARF	Variable frequency output
E1-3	Event time mark inputs
TXD1,2	Serial transmit data output RS-232
RXD1,2	Serial receive data input RS-232
S1-7	Spare/reserved pins for contractor use
ST-1, -2	Status 1 and 2
EPS	Epoch pulse strobe
KEY	Keyed at pin 36
D1-D11	Digital parallel outputs and handshake signals
Mode	Selects sensor or navigation mode

A.3.2.2.3 GSU data connector input and output. The GSU shall provide the following electrical and signal interfaces through the data connector:

a. Power inputs to the GSU.
b. Data output from the GSU.
c. Programming/test serial port.
d. Serial data port.
e. Status bits.
f. Epoch pulse strobe.
g. Event mark input.
h. Variable frequency output.
i. Digital parallel outputs

A.3.2.2.4 Parallel Port Signals. These signals are for GSU output only and are not required to interface with the JTU input.

A.3.2.3 Power input.

A.3.2.3.1 Supplied electrical power. The GSU shall be supplied electrical power by the JTU as follows:

a 5 VDC ± 2% line plus load, 100 ma maximum. The 5 VDC supply shall go into current limit if the load resistance becomes too low. This power is dedicated for the filter-limiter-preamplifier, which the GSU supplies through the center conductor of the antenna connector, J1.

b. 3.3 VDC ± 2%, 300 ma maximum.

c. 1.8 VDC ± 2%, 560 ma maximum.

A.3.2.3.2 Input power quality. The GSU shall operate normally as described herein with a ripple voltage of 0.005 volts at frequencies from 10 Hz to 1 MHz imposed on all input power lines.

A.3.2.4 Message data output. The GSU shall output three messages. The combined maximum average bit rate between air and ground for these messages shall be not greater than 120 kilo bits per second. The messages shall be output at the ground at the same rate as the airborne measurements.

a Missile application time message.

b. Missile application condensed measurements.

c. Position, velocity, time message.

A.3.2.4.1 MATM.

a. The MATM shall be at a rate specified in the ordering information.

b. The MATM message shall contain the three event mark time stamps.

c. The MATM shall be output once between each MACM message and shall preempt or interrupt a single MACM message output at the time of an event mark input. The next MACM message shall be output at the next regular interval.

d. The delay between the event mark and the beginning of the output of the MATM shall not be longer than two bytes of the serial port.

A.3.2.4.1.1 MATM format. The MATM message shall be broken down MATM [4] T1 [4] T2 [4] T3 [4] Checksum [1]: [17 bytes] defined as follows:

MATM	Four-byte sync word. [The ASCII* character (char) ("MATM")]
T1	Four byte time stamp for event mark input #1, μs of the hour, units of 0.1 μs
T2	Four byte time stamp for event mark input #2, μs of the hour, units of 0.1 μs
T3	Four byte time stamp for event mark input #3, μs of the hour, units of 0.1 μs
Checksum	One byte checksum of T1, T2, and T3

*American Standard Code Information Interchange

A.3.2.4.2 MACM message. The MACM message is a data format designed for high-speed output of raw GPS measurement data.

a. The carrier-to-noise ratio, carrier phase measurement, pseudorange, carrier phase rate, elapsed lock time, and condition flags shall be supplied for each satellite under track.

b. The MACM message shall be output at a rate specified in the ordering information with the MACM immediately following the MATM.

c. A single MACM message shall be pre-empted by a MATM at the time of an event mark to the GSU.

The GSU shall provide continuous GPS data from the initial position solution at the above stated rates.

A.3.2.4.3 PVTM.

a. The PVTM shall contain latitude, longitude, altitude, velocity east, velocity north, velocity up, and GPS time of the of the week to millisecond accuracy.

b. The PVTM shall be output at a rate specified in the ordering information and incorporate 4 or more satellites, all within 3.0 seconds of application of RF.

A.3.2.4.3.1 PVTM format. Table A.VIII shows the PVTM format and number of words required.

TABLE A.III. PVTM format.

Name	Number of Bytes	Data Type	Definition
PVTM	4	Character	PVTM
Time, Millisecond of the Week	4	Unsigned Integer	Universal time corrected (ms)
Latitude	4	Signed Integer	± 90 Degrees
Longitude	4	Signed Integer	± 180 Degrees
Altitude	4	Signed Integer	± Feet corrected for mean sea level (Least significant bit equals one foot)
East Velocity	2	Signed Integer	± 65,535 feet/second
North Velocity	2	Signed Integer	± 65,535 feet/second
Up Velocity	2	Signed Integer	± 65,535 feet/second
Checksum	1	Character	Checksum includes all bytes through the end of the message except PVTM and Checksum.

A.3.2.5 Programming/test port. The CDU TXD1/RXD1 port shall be an RS-232 data communication equipment (DCE) protocol compatible input/output in accordance with EIA Standard RS-232F. It shall be the communication port used for controlling the GSU at the GSU level. This port will not interfere with the JTU. The port shall be capable of::

a. Be compatible with a laptop computer serial data exchange.

b. Support manufacture specified GSU diagnostics.

c. Support programming and/or testing of the GSU at the GSU level only.

A.3.2.6 Serial data port. The TXD2/RXD2 port shall be an RS-232 DCE protocol compatible input/output in accordance with Electronic Industries Association Standard RS-232F. It shall be used for outputting MACM, MATM, and PVTM, when selected through the CDU port. The serial data port shall output data at 230,400 Baud with 1 stop bit, no parity, and flow control off.

A.3.2.7 Status bits. The GSU shall drive two outputs ST-1 and ST-2 via the data connector, sinking 1 ma from a 5.0 VDC source.

A.3.2.8 Epoch pulse strobe. The GSU shall provide an output synchronization pulse that is coincident with the MACM message epoch sample referred to herein as an EPS.

a. The EPS shall be open collector, active low strobe coincident with the epoch measurement.

b. The leading edge of the EPS shall be coincident with the on-time of the GPS time of validity as defined for the MACM message and shall be 0.5 to 1.0 μs wide.

A.3.2.9 Event mark input. The GSU shall provide for the input of three event marks. The event mark inputs shall be 3.3 VDC complimentary metal oxide silicon (CMOS). The high-to-low transition defines the ON time mark. The event mark input pulse width is 100 nanoseconds minimum and may or may not return high before the end of the mission.

A.3.2.10 Variable frequency output. The GSU shall provide a variable frequency output with a pulse width of 100 ns, sinking 1 ma from a 3.3 VDC source. The frequency of the output signal shall be capable of being set to values between 100 Hz and 1.0 MHz with an accuracy of 1×10^{-6} and a noise level of 1×10^{-7}. The Leading edge of the frequency pulse shall be synchronous with the epoch pulse. The frequency shall be programmed from the CDU.

A.4.0 VERIFICATION

A.4.1 Inspection and verification. See 4.0

A.5.0 PACKAGING

A.5.1 Packaging for acceptance delivery. The GSU packaging for delivery to and acceptance by the government shall be as specified in the contract.

A.5.2 Packaging for storage or other special packing.

a. If the GSU design requires special packaging provisions to meet the GSU storage environment requirements or storage life specified herein, a list of packaging materials, sources for the packing materials, and any special equipment to accomplish the packaging along with estimated costs to accomplish the packaging per unit shall be submitted for approval before the GSU design is finalized (see 6.2).

b. If special packaging is required, detailed packaging instructions, list of materials, and sources for the materials shall be provided with each GSU.

c. Any such special packaging shall be in addition to, and inside the packing required for delivery.

A.6.0 NOTES

This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.

A.6.1 Intended use. See 6.1

A.6.2 Acquisition requirements. See 6.2

A.6.3 Abbreviations and acronyms. See 6.3